Ohio Agricultural Experiment Station.

BULLETIN 119.

WOOSTER, OHIO, JUNE, 1900.

THE HESSIAN FLY IN 1899 AND 1900.

The Bulletins of this Station are sent free to all residents of the State who request them Persons who desire their address changed should give both old and new address. All correspondence should be addressed to

EXPERIMENT STATION, WOOSTER, OHIO.

COLUMBUS, OHIO
FRED J. HEER, STATE PRINTER
1900

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The Bulletins of this Station are issued at irregular intervals. They are paged consecutively, and an index is included with the Annual Report, which constitutes the final number of each yearly volume.

BULLETIN

OF THE

Ohio Agricultural Experiment Station.

NUMBER 119. JUNE, 1900.

THE HESSIAN FLY IN OHIO IN 1899 AND 1900.

BY F. M. WEBSTER.

It has been many years since the Hessian fly has worked such havoc in the wheat fields of Ohio as it has during the fall of 1899 and the spring of 1900.

CAUSES OF THE PRESENT SITUATION.

The causes leading up to this condition of affairs are several:—

(1) The pest was destructively abundant in the spring of 1899, thus furnishing an ample basis for the present abnormal abundance.

(2) For some reason, not at all clear, the parasites of this pest became so reduced in numbers as to offer no obstacle to the increase of the Hessian fly in 1898 and 1899, whereas these friends of the farmer constitute one of the most efficient checks on the increase of this pest, and, largely at least, tend to keep it so reduced in point of numbers as to render outbreaks like the present impossible.

(3) The continual mild weather of last autumn, i. e., that of 1899, enabled even the very late deposited eggs to hatch, and the young from these became sufficiently developed to enable them to withstand the winter, whereas a less favorable fall than that of 1899 would have caused the destruction of many of the young.

(4) As shown further on, the severe drought that prevailed all over Ohio during August and September, 1899, retarded the development of the fall brood of flies, from fully three weeks in the extreme northern part of the state, to only a few days in the southern section. In the northern part of the state this delay in the appearance of the fly would so delay the appearance of the young that unfavorable weather, had it set in early, would have killed off myriads of these, whereas the weather

conditions being of the most favorable, enabled them to reach maturity uninjured. Not only this, but wheat sown in the northern half of the state, long after the fly has, ordinarily, come and gone, was pushing up its first slender shoots just as the flies were abroad in search of such fields as these in which to deposit their eggs. Thus a combination of circumstances which the wisest could not have foreseen led up to the present situation as regarding the abundance of the Hessian fly. (See Map).

MAGNITUDE OF THE DESTRUCTION.

In point of destruction, the Hessian fly outranks every other insect, when considered in connection with the wheat crop of 1900. It is doubtful if there will be over 20% of an average crop; the balance of 80% may be largely charged up to the ravages of this pest. As an average crop in Ohio amounts to approximately 40,000,000 bushels the loss may be computetd at 32,000,000, bushels which, at the ruling market price, would mean a loss of $22,400,000, at least three-fourths of which, or $16,800,000, can justly be charged up to the ravages of the Hessian fly. More extended studies of this outbreak, and some of the meteorological phenomena connected therewith, are given farther on. In many localities the later sown wheat escaped fall attack, and up to May 1st, 1900, was uninjured, but the flies developing in the earlier sown fields seemed to have migrated *en masse* and settled down on those sown later, and the result is that in many cases the destruction is as complete in one as in the other.

METEOROLOGICAL INFLUENCES ON THE DEVELOPMENT OF THE HESSIAN FLY.

It has for some time been understood that the appearance of the fall brood of adults of this species is subject to some variation in regard to date, due to meteorological influences. But, beyond the fact that cool, damp weather, during the breeding seasons was supposed to be favorable to the development of these insects, comparatively little has been learned in this country that is applicable to field conditions. Even now, the writer does not claim to have done more than to secure some data worth placing on record.

Before entering upon a discussion of the facts secured in Ohio during the autumn of 1899 and the spring of 1900, relative to the Hessian fly, I beg to call attention to the observations of Dr. W. Paspelow, Assistant in the Zoological Cabinet, Agricultural Institute, Moscow, Russia, and cited by Prof. Osborn in Bull. 16, Div. Ent., U. S. Dept. Agr., p. 22.

"Toward the end of May the greater portion of the larvæ transformed to the puparium stage. In the beginning of July the first true pupæ were found, and, at the same time, the adult flies emerged from pupæ kept in a glass. In the first

Map, indicating in bold faced type, the approximate dates immediately after which it is usually safe to sow wheat in the fall, in various sections of Ohio, in order to avoid the autumn attack of Hessian fly.

Dates given in small type, show when wheat sown in the fall of 1899 did escape the fall attack, though it was in many cases totally destroyed by the spring attack. The difference between these dates is the variation from the normal, and, where no dates are given between the cross lines, there was no such variation.

half of June a number of puparia transformed to true papæ; but the principal portion of the Hessian fly (70 to 80%) remained in the puparium stage. Toward the end of July and the first half of August there were, in the field, exclusive puparia to be found. * * * From this we can deduce that the emerging of the summer generation, which had begun in June, stopped very quickly, so that the first appeared in the autumn end of August and beginning of September. Such retardation in the course of development of the Hessian fly was due to the high temperature and great drought of the past summer, whereof one could easily be convinced by placing the puparia in a moist space in glasses in damp sand, which were placed in moist and shady places in the park. In such cases perfect flies developed from the puparia brought in from the fields, in two weeks. Puparia left in the field, remained in the puparium stage an unusually long time, until in the second half of August, under the influences of rain, they transformed first to true pupæ and after that finally to adult flies.

"The weather conditions of this year increased the difficulty of fighting the Hessian fly in high altitudes. The wheat fields, namely, such as were sown in June for the purpose of attracting the Hessian fly, could not fulfill their mission, because the fly at this time had not yet emerged.

"The recommendation made by several entomologists to delay sowing until August could not protect the crop from the Hessian fly, because it emerged just at this time."

In Ohio, the Hessian fly begins to emerge nearly or quite a month earlier, in the autumn, over the northern parts than it does in the extreme southern parts, the time extending, approximately, from September 10th in the north, to October 10th in the south. But in September, 1899, a severe drought prevailed nearly throughout the state, having, in fact, begun in August. No general rain of any importance occurred until September 19th, with a much greater precipitation on 25th of the same month. There were light rains on 1st, 5th, 6th, 7th and 8th, but these were so light as to make little impression on the severe drought prevailing at the time, except in Wayne county, in the vicinity of Wooster, where the precipitation was on those dates as follows:—1st, 0.74; 5th, 0.05; 6th, 0.22; 7th, 1.25; 8th, 0.60, or for the period from 1st to 8th, 2.86 inches, enough to thoroughly saturate the ground to the depth of several inches. This exception is recorded here, as, further on, the influence upon this problem will be indicated.

Throughout the entire state, except in the extreme northwest and southwest portions, the precipitation during August, 1899, was below the normal. During the month of September, the temperature was, in most localities, below the normal, while nearly one-half of the observers of the weather bureau reported an excess of precipitation, above the normal, but it must be remembered that this came almost exclusively after the 18th, and, much of it, after the 25th of the month, a date after which wheat may be sown south of Columbus, Lat. 40°, usually without danger from fall attack of the Hessian fly. As shown by Dr. Paspelow, the flies would not appear for several days after the rains came, so there would occur a still farther delay of a few days, and the retardation from drought would extend still farther to the south than Columbus, though

to a much less degree. In other words, the retardation would be greatest in the extreme north, and decrease to the southward, until the date of copious rains coincided with the normal time of appearance of the flies, which would be between Lat. 39° 30′ and Lat. 40°, or between Columbus and a little to the south of Circleville. South of the latter the effect of this rain would be, and doubtless was, to cause the fall brood of flies to appear promptly at the normal dates. Thus, in Ashtabula county, wheat sown as early as the 10th of September should ordinarily escape the fly; whereas, wheat sown at any time in September, 1899, was seriously affected, and, as a rule only that sown after the 2nd or 3rd of October, over three weeks later than usually has been necessary, escaped the attack of the Hessian fly. To the south, between Lat. 41 and 40 30′ the retardation was practically unchanged from what it was to the north, except that it was not quite so prolonged; as, fall wheat sown from the 15th to 18th of September, under normal conditions, will escape the fall attacks of the fly. Between Lat. 40° 30′ and Lat. 41° wheat sown immediately after the 20th of September is usually safe from attack of Hessian fly, as seven years' observation and experimentation on the farm of the Agricultural Experiment Station, at Wooster, has shown. In portions of Wayne, Stark, Ashland and Columbiana counties, and in Wayne especially, where the copious rains of early September saturated the dry soil, breaking the drought, and, as it would seem, bringing out the adult Hessian flies at about the normal time, as wheat sown after September 20th largely escaped the fall attack, as was witnessed by the much better appearance of the fields of wheat in general, not only in Autumn, but up to the harvesting of these fields.

This fully bears out the idea that wheat may be sown in any locality, soon after a certain date, with little danger from the Hessian fly, and also, very nicely, as it appears to me, the retarding influences of drought, as well as the effects of timely rains in bringing out these insects at their usual time of appearance, where such precipitation takes place a week or ten days prior to the time of usual appearance. In other words, we have here illustrated in two different ways, the fact that the same meteorological conditions that will prevent the germination of the seed and growth of their food plant, retards the development of the Hessian fly, probably, during a long period of time; thus does Nature protect the weakest and most helpless of her children.

Between Lat. 40° and 40° 30′, it is usually safe to sow wheat in the fall, after the 25th of September, but as it was not until that date that any considerable rains occurred, the flies were still retarded in their appearance, but for a still more limited period; examination of many fields in this belt, show that after October 4th wheat might have been sown with safety—a variation of about nine days from the normal.

Between Lat. 40° and 39° 30′ the normal date for sowing with safety is September 30th, and we find here a variation of from one to five days

only from the normal. Between Lat. 39° and 39° 30′ there does not appear to have been any variation from the normal in time of appearance of the fall brood of flies, because the rains of the latter part of September had the effect of bringing about normal and favorable meteorological conditions, both as regarding the germination of grain and the development of the fly. Throughout the last mentioned zone, the rains of the latter part of September induced very many farmers to sow their wheat at once, instead of waiting until after the danger period had passed, with the result that in almost every case where this was done, the crop was nearly or quite a total loss, owing to the fall attack of the Hessian fly. On the other hand, farmers who delayed sowing until the danger had passed were rewarded by a luxuriant growth of grain, comparatively free from attack of fly, in the fall. The sequel, however, was in many cases disastrous, as, in many instances, the spring brood of flies forsook the ruined fields in spring and swarmed over those that had so far escaped, utterly ruining these by reason of their spring effect. Thus did the careless or unobserving farmer not only cause the ruin of his own wheat crop, in the fall, but, by his mismanagement, that of his more observant neighbor the following spring.

The foregoing facts have been gained by the critical examination of a great number of fields of wheat, both during the autumn and spring by myself and assistants; by the careful collection of data as to date of sowing of these fields, and the comparison of the facts thus obtained with the records of the United States Weather Bureau, kindly placed at my disposal by the section director, Mr. J. Warren Smith.

Of course, in these investigations, many dissimilar conditions and influences have been encountered. In some instances wheat sown very early, under the influence of local showers, sprung up and made a good growth, escaping the fly because these, on account of it being still too early, had not yet appeared, and that sown later appeared to be more attractive on account of being less tough, thus, as it were, drawing off the Hessian flies from the early sown fields, and showing almost exactly the date on which these pests were abroad in the field and depositing their eggs. Then, too, there would be a decided difference between wheat sown on stubble ground where the previous crop had been injured by the fly. The resistant qualities known to belong to some varieties of wheats, and the attraction that others seem to have; the great difficulty experienced in learning the exact dates on which fields were sown; the protracted warm weather of the autumn of 1899, which extended well along till December, have all increased the difficulties of carrying out these investigations. A concensus of all the facts that we have been able to gain have been given herewith, and probably constitute the first attempt to study systematically in the fields, over three degrees of latitude, the exact influence of temperature and precipitation on the development of the Hessian fly in late summer and autumn.

THE PRESENT SITUATION.

The foregoing will indicate quite clearly the causes that have brought about the present enormous abundance of, and destruction by the Hessian fly. At present, the stubble fields are full of the pest passing the months of July, August and more or less of September, according to latitude, in what is known as the "flaxseed" stage, during which the insect is rolled up within the thin, brown covering and requires no food. The enemy is among the stubble, underneath the old leaf sheaths, helpless as though it was devoid of life. Though there may be some parasites present, I have nothing as yet to show that these are present in sufficient numbers to offer any material aid in suppressing the pest. The only hopeful feature is the fact that many fields were so totally destroyed that myriads of young must have perished for lack of food.

THE PROSPECTS.

Thus it will be seen that the prospects for an abundance of flies the coming fall is exceptionally good, although this does not prove conclusively that they will be more, or even equally as abundant as during a similar period in 1899. Farmers all over the state are asking themselves, each other and me, whether or not, it will pay to sow wheat at all the coming autumn. Many letters have come to me during the last few weeks, asking numerous questions along this line, which will be replied to under the following headings, so far as it is possible to do so.

SHALL WE SOW WHEAT?

If I had wheat lands of my own in Ohio, I should certainly sow wheat, though this is a question that each person must settle for himself. I should, however, be very careful when I sowed and take especial pains in the preparation of the land and selection of the seed.

MANAGEMENT OF LANDS TO BE SOWN TO WHEAT THE PRESENT YEAR.

The coming season promises to be a risky one during which to grow a good crop of wheat, on poor soil.* Therefore, when possible, use only the most fertile fields for this purpose. Burn over every stubble field possible, during August or early September, and induce your neighbors to follow the example. To do this, run the mower over the fields cutting off as close to the ground as possible the weeds, grass and old stub-

*Late sown wheat on unfertilized ground, on the Experiment Station farm, did not suffer from fall attack of fly, but was totally destroyed by the weather during winter. Fertilized plats suffered to some extent on account of the winter and also by the spring attack of fly. F. M. W.

ble in order to get fuel with which to burn over the fields, which should be undertaken as soon as the weeds and grass have dried sufficiently to burn readily, and there is a good, stiff breeze from the right quarter. When stubble is seeded with grass or clover this cannot be done, but there should be no other exceptions, if possible to avoid them. This will destroy all Hessian flies in the fields so burned over, and a roasted fly is worth any number of healthy ones. It will pay to secure a finely pulverized, compact seed bed. No matter how, so that you can get it. A blanket of finely pulverized soil is a cheap mulch that will help to hold the moisture underneath, and, to this extent, aid in pushing the plants forward later on, even though there should be a lack of rainfall.

THE SEED.

This subject is only included here in order to call attention to and emphasize the statements made by Mr. Hickman in Bulletin 118. There are resistant varieties, but none that are fly proof. This is recognized in other countries as well as in America.

TIME OF SOWING.

The dates given in Bulletin 107 of this Station were, as was stated, approximate, and not necessarily exact. They were based on 14 years' observation and experimentation in Indiana and Ohio, and, I still believe, represent, as nearly as it is yet possible to do so, the approximate dates after which it will be safe to sow wheat in the fall, *during ordinary years*. That the dates cannot be relied upon in exceptional seasons, has been proven by the experience of last year and the present, and, the reasons therefor have been fully explained under another head, in this publication. I have never before had the opportunity of investigating the Hessian fly under such unusual conditions, and this has never been done before in this country by others.

We now know that hot, dry weather during August, September or October will retard the development of the fly. It is obviously impossible to say just how hot and dry it must be to have this effect, but I think it will be safe to say that when this is sufficient to prevent the wheat from germinating it will suffice to keep the fly in the "flaxseeds." In the northern part of the state August weather will affect the appearance of the fly. In central Ohio that occurring during late August and the first part of September will have this effect, while in Southern Ohio, September weather alone will need to be considered. Judging from what we now know, the flies will come forth from the flaxseeds about a week or ten days after a drenching rain occurs preceded by a severe, prolonged drought, provided the time has arrived for them to appear under normal conditions. In other words, in the extreme northern part

of the state, if the latter part of August and up to the 10th or 15th of September has been very dry, the fly will not, as yet, have appeared and laid its eggs, and will not do so for a week or ten days after the drought is broken. In the extreme south, if the month of September has been hot and exceedingly dry, the fly will probably not appear for a week or ten days after the drought is broken. It is easy to see that no set rule can be laid down, but each farmer must decide for himself what, in his locality, will constitute late sowing and when he shall sow.

VOLUNTEER WHEAT.

So far as possible this should be destroyed. The most unsafe place to sow wheat is after wheat. When this is necessary, keep all volunteer wheat killed down by disking, or whatever method will best accomplish this end.

SOWING OTHER GRAINS.

Wheat, rye and barley are all attacked by the fly and little will be gained by substituting the two latter for wheat, unless sown very late for winter pasture. The Hessian fly cannot live on any other grains and on none of the grasses, so far as we know.

PASTURING INFECTED FIELDS IN THE FALL.

Good often results from pasturing infected fields with sheep in the fall. The light weight and small hoofs of these animals pack the surface of the ground and crush many of the young of the Hessian fly, without injuring the wheat plants, if the sheep are not kept too long in the fields.

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